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Integrative Analysis and Modelling in the RENMAN project (Workpackage 5)

Introduction

One main target of the RENMAN project was to find ways to intensify the discussion and participation of the stakeholders involved in reindeer husbandry. To support this process, it was unavoidable to provide usable data and information and to make them available for all participants. Our contribution to the project included the integrative analysis of the different demands for landscape utilisation from social, economic and ecological aspects and the analysis of the reindeer husbandry and management system as a whole.

Methods

We developed a conceptual model showing important processes in reindeer herding (Fig. 1), conceptual models of the socio-economic and ecological interactions and derived a set of 32 indicators for an evaluation system for the ecological, social and economic sustainability of different landscape management regimes (Fig. 2). The above mentioned components were substantially and organisationally tightly integrated with the other disciplines in RENMAN. For the management, analysis and presentation of the data pool provided by our project colleagues and ourselves Geographical Information Systems (GIS) and computer based models were used, which will be applied for the simulation of different scenarios. Those simulations will be interpreted to compare and evaluate different reindeer management systems. For the system analysis and modelling tasks, the main challenge can be seen in the integration of socio-economical and ecological factors to depict a figure of reindeer management as a holistic entity and in the application of the results for the enhancement of sustainability in local decision making processes. For the acquisition of data and information, various field trips were carried out during the last three years in co-operation with the other workpackages in RENMAN.

The visits in Finland were furthermore used to present and discuss the results of the system analysis and modelling work with the project colleagues and selected experts, which thus could be involved into the whole model and indicator development process.

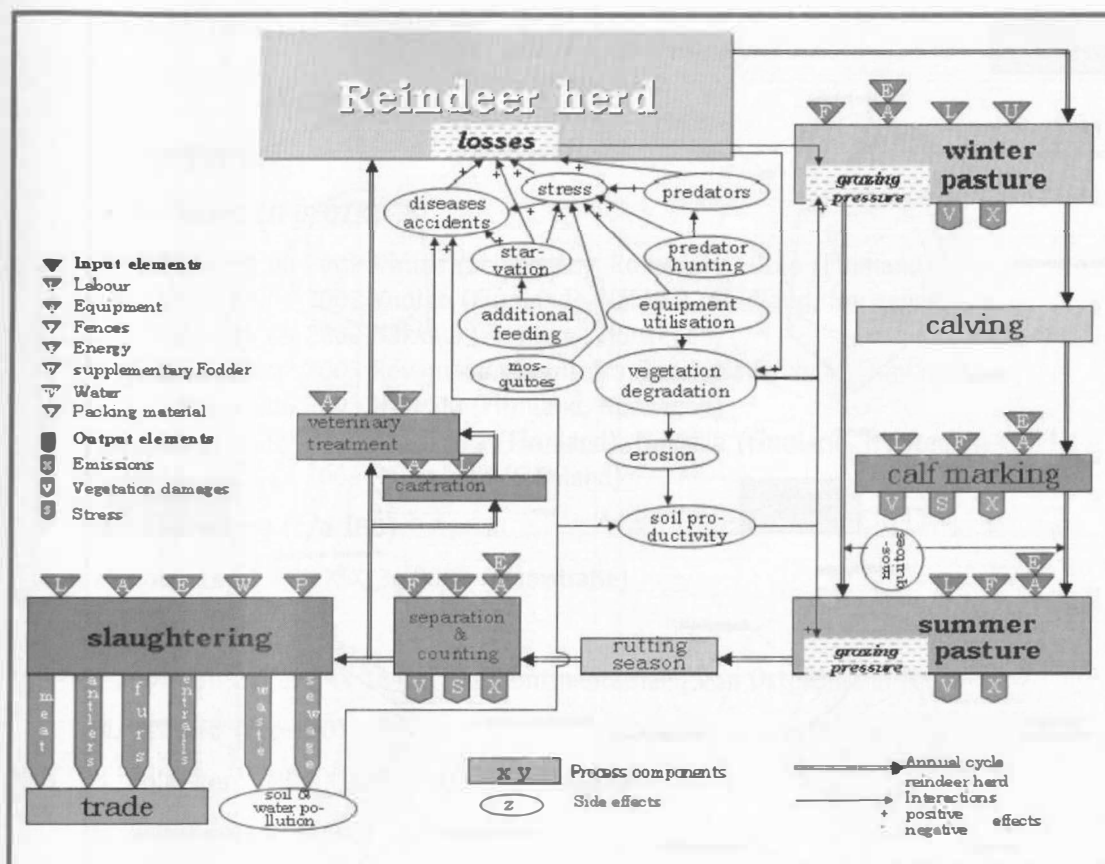


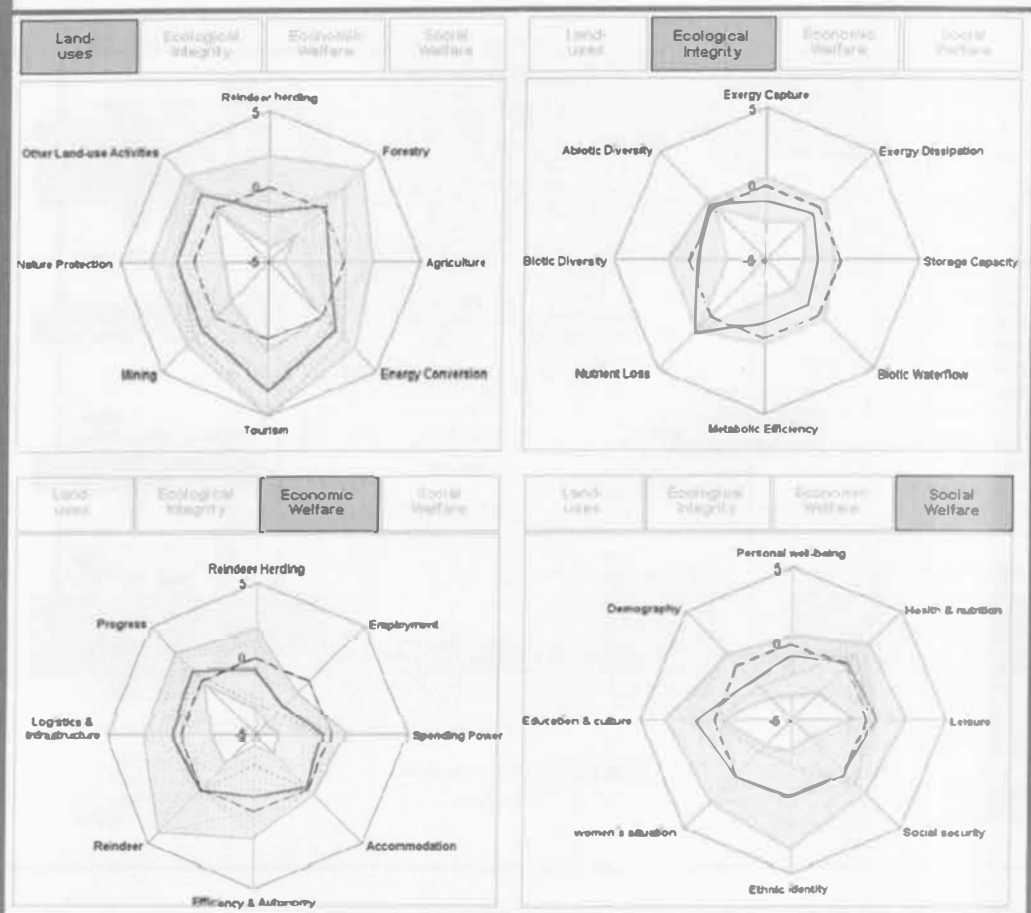
Figure 1 Conceptual model of the reindeer husbandry system, showing the annual cycle of reindeer herding with the reindeer herd as the central element associated with certain inputs (like labour, reindeer fences, herding equipment, energy, supplementary fodder) and outputs (like meat products, antlers, furs, waste, vegetation damages, emissions).

Results

The developed conceptual model (Fig. 1) can support the understanding of a complex system like reindeer husbandry. The reindeer herd represents the central element associated with certain in- and outputs. The model is designed to follow the seasonal rhythm of reindeer herding with winter and summer pastures, calf marking, separations and slaughtering and gives an illustrative overview of the system reindeer management. The points of main interest within the system shown in Figure 1 are changes and developments. What happens if certain elements are changing, if for instance the sizes and qualities of the pastures are shrinking or if the size of the reindeer stock is changing? What would be the reaction of the stakeholders? Would the inputs into the system be raised in the form of supplementary feeding or an increased amount of work? Which would be the expected economical, social and ecological consequences? To measure and quantify such developments, an appropriate indicator system was developed, which integrated the data and information available from the research activities in RENMAN.

With the help of these data and the results from expert consultations we were able to carry out various scenario simulations for reindeer husbandry. A "business as usual" scenario simulation (Fig. 2), which assumes that all processes, institutions and connections in reindeer husbandry will in future be treated in the same way as nowadays, shows for example drastical changes in the land-use structures

Figure 2 Indicator set, describing the reindeer husbandry system's state after 25 years as developed according to the scenario "business as usual" simulation (0 = no change, 5 = strong increase, -5 = strong decrease, the thick line indicates the mean values, individual, minimum and maximum values are represented by the amoeba body); Note: preliminary results, particularly the "Ecological Integrity" diagram will be upgraded by further model outputs.



(e.g., decrease of reindeer husbandry, increase of tourism), rather slight changes in the ecosystem state and would have noticeable consequences on the socio-economic sections of the system.

Discussion

By simulating scenarios, different reindeer management systems were analysed and evaluated for their degrees of sustainability. Thus our work, which integrated the results of different disciplines as well as the knowledge from local people, can help to promote the design and negotiation of policies into a more sustainable landscape management direction. This means that the future decision making has to consider the environmental conditions as a base for the livelihood of reindeer herding but also take into account the economic and social welfare of the local people.